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ABSTRACT

The primary purpose of this study was to evaluate the effectiveness of the university level multi-disciplinary course in the environment on bringing about heightened awareness of environmental events as reported in the mass media. A second, related study sought to determine whether particular values characteristically associated with the various disciplines could be modified by such a course experience. Experimental subjects, 61 students in the University of Tulsa, were administered an Environmental Events Awareness Scale and the Allport-Vernon-Lindzey Study of Values, both prior to and at the end of a multi-disciplinary university course entitled "Science, Technology and the Environment." The results indicate no heightened awareness of the experimental subjects, as measured by the Environmental Evants Awareness Scale. Data indicate there was actually a decrease in the awareness of such environmental events at the end of the course experience. Similarly, the results revealed little change in selected values as a function of exposure to the course material. (BL)

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Final Report

Project No. 2F005
Contract No. OEC-6-72-0675 (509)

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EVALUATION OF A UNIVERSITY COURSE IN THE ENVIRONMENT

July 1972

U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE

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National Center for Education Research and Development
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The primary purpose of the current study was to evaluate the effectiveness of the university level multi-disciplinary course in the environment on bringing about heightened awareness of environmental events as reported in the mass media. The second study sought to determine whether particular values characteristically associated with the various disciplines could be modified by such a course experience. Experimental subjects were administered an Environmental Events Awareness Scale and the Allport-Vernon-Lindzey Study of Values, both prior to and at the end of a multi-disciplinary university course entitled "Science, Technology and the Environment."

The results indicate no heightened awareness of the experimental subjects, as measured by the Environmental Events Awareness Scale. To the contrary, the data indicate that there was a decrement in the awareness of such environmental events at the end of the course experience. Similarly, the results revealed little change in selected values as a function of exposure to the course material.

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Tulsa, Oklahoma

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The research reported herein was performed pursuant to a contract with the Office of Education, U.S. Department of Health, Education, and Welfare. Contractors undertaking such projects under Government sponsorship are encouraged to express freely their professional judgement in the conduct of the project. Points of view or opinions stated do not, therefore, necessarily represent official Office of Education position or policy.

U.S. DEPARTMENT OF
HEALTH, EDUCATION, AND WELFARE

Office of Education
National Center for Educational Research and Development

PREFACE

The investigators wish to express their appreciation for the cooperation of Dr. Nancy Feldman and Dr. Katherine Jones in making this study possible. Their further cooperation in making the experimental subjects available for this study is deeply appreciated.

Thanks also to Professor Bruce Ketcham, Director of the University of Tulsa's Faculty Research Grant Program. His assistance in the investigators being awarded a faculty research grant was indispensable to the research effort.

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INTRODUCTION

A recent article in American Education, by U.S.O.E. Commissioner S. P. Marland, Jr. (12) expresses the sentiment that environmental education must be a high priority educational theme. Commissioner Marland cites the words of the President, and reiterates his emphasis with respect to environmental education: "We must achieve a new awareness. . . with respect to the modification of man's attitude towards his environment." The Commissioner continues: "Environmental education is directed at modifying man's attitudes towards his world--both the world of nature from which he derives and inherits his responses, and the world which he has created."

Unfortunately, the traditional science and engineering courses in universities have shown little concern for the development of social responsibilities as part of their professional objectives. By the same token, those responsible for the planning of training programs in the social sciences have been equally unconcerned in their treatment of the effects of technical advances on man's mode of living. While the products of the various sciences and technologies have had a positive effect on man's living conditions, there have also been concomitant by-products which have been disruptive of man as a social being interacting with his environment. Since the discovery of these disruptive by-products, we are now observing a further awareness of, and interest in, environmental and social problems on the part of scientists and engineers, as well as educators and social scientists. It is imperative that new forms of academic cooperation and organization be developed. Scientists, engineers, and social scientists must participate cooperatively in addressing environmental and social problems. The cooperation of many disciplines, each with unique insights and contributions, should yield a more satisfactory means of understanding man's environment.

A literature review of the ERIC system and other sources has revealed how infrequently in higher education, the various disciplines have collaborated in a cooperative effort to address the problems of technology and society. This review (1, 2, 4, 13, 16) indicates that the educational efforts have not been of a multi-disciplinary nature, nor have there been attempts to evaluate the effectiveness of those environmental study programs which have been attempted.

A major reason for the paucity of adequate multi-disciplinary efforts is probably a function of the consistently noted interest, values, and attitudinal characteristics strongly associated with the respective disciplines. Many studies (3, 5, 10, 11, 14) have documented the existence of such discipline-related patterns. Such consistency may militate against the development of multi-discipline approaches to problems of society. While these above studies have tended to corroborate the existence of, and stability of, such personal characteristics, few studies have ever considered whether or not such characteristic tendencies and associated behaviors can be modified. Because of these tendencies, the engineer, for example, has been observed to address social problems exclusively from an engineering or technological approach, while a social scientist utilizes, for his data, persons and social systems.

In view of this current situation of few multi-disciplinary academic efforts towards understanding problems of the environment (3, 14), the current research paper proposes to evaluate a recently developed multi-disciplinary course, "Science, Technology, and Society", encompassing the humanities, the social sciences, engineering, and the natural sciences (see Appendix A), by conducting two related studies.

The first of these two studies seeks to determine whether such an academic experience can result in a heightened awareness* of the environment outside the classroom itself, while the second study will examine whether particular values characteristically associated with the various disciplines can be modified by such a program.

*Awareness is operationally defined by the Awareness of Environmental Events Scale, which is described under the instrumentation section.

METHODS

Subjects: For purposes of clarity, the reader should keep in mind that the same experimental population was used for both of the studies. The experimental group consisted of 61 students who were enrolled in February, 1972, in a university course entitled Science, Technology, and Society", which had been developed recently by two University of Tulsa professors, Dr. Katherine Jones and Dr. Nancy Feldman. (While the investigators had anticipated an N of approximately 200 experimental subjects, a reduced Spring enrollment yielded an unanticipated N of 61.) These students will hereafter be referred to as the experimental group. Enrollment in the course was university-wide, with representation from each of the colleges of the University (i.e., engineering and physical sciences, arts and sciences, business administration, and education). The prerequisite for admission into the course was sophomore or higher academic standing.

The investigators recognized that a self-selection bias with respect to the experimental group could be operating, since those who had selected the course experience may have had a pre-existing interest in the problems of the environment. Such a possibility will be examined.

A control group (N=247) was selected from the respective participating colleges of the University. A stratified random sampling technique (stratified by collegiate standing of sophomore, junior, or senior), was utilized in the selection of the control group. The investigators felt that in the present study, a control group must be utilized in order to control for possible heightened awareness of the general university population, should unique environmental events occur and be extensively reported in the mass media, while the environments course was in progress. Such events might tend to heighten awareness of the entire university community and mask any contributions to heightened awareness from the course experience.

Instrumentation: The first study sought to investigate heightened awareness of the environment as a function of the course experience. The investigators developed the Awareness of Environmental Events Scale for this purpose. The scale was developed prior to the course itself (for pre-test purposes), by systematic monitoring of the two Tulsa newspapers and the four television stations which Tulsa receives. Environmental events consisted of international, national, and local environmental, scientific, and technological occurrences. Monitoring continued while the course was in progress in order to develop the post-test Awareness scale. Student assistants accomplished the monitoring by selecting "major news items"* from the two Tulsa newspapers. Special television programs dealing with science, technology, or the environment were taped by student assistants, transcribed, and thus utilized for item selection. The awareness scale incorporated the concept of content validity, one of the major types of validity as described by Cronbach (7). That is, a representative sample of the universe of possible items was compiled through the systema-

*See Appendix - for operational definition of major news item.

tic monitoring of the media described above. The universe of items in the current situation was defined as all major environmental events occurring and reported in the specified media over the time periods described. The actual test items were generated from descriptions of the environmental event in the particular medium, with the items being cast in an objective form. The sample items* were then administered to a group of university students in order to eliminate ambiguities, and also to establish the difficulty level of the items.

According to Guilford (9) and many other statisticians, the maximum discriminability of an item is achieved when its level of difficulty is approximately .50, that is, there is a 50% probability of answering the item correctly. Therefore, only those items which were determined to have approximately a 50% level of difficulty were included in the final instruments.

The Allport, Vernon, Lindzey Study of Values was utilized in Study II in an attempt to detect value changes as a function of the course experience, and differential value changes between the involved disciplines. For example, do engineers experience a significant change in specific values, and how do such changes on the part of engineering participants compare with those changes on the part of the social scientists?

Procedures: During the first week of class the Awareness of Environmental Events Scale was administered to both experimental and control group subjects in order to establish a "baseline" of environmental awareness on the part of the experimental subjects, and also to determine whether or not a self-selection bias was operating with respect to the experimental group. This latter determination was made by comparing the pre-test awareness scores of the experimental and control groups. The investigators recognized that a self-selection bias could have been operating, since those who had selected course experience may have had a pre-existing interest in the problems of the environment.

*See Appendix - for scales.

HYPOTHESES

Study I

Hypothesis: The experimental group will exhibit greater "awareness" than the control group, as measured by statistically significant gains on the post-test awareness scale.

Study II

Hypothesis 1: There will be no significant pre-test - post-test differences for engineers on the Aesthetic value scale of the Study of Values.

Hypothesis 2: There will be no significant pre-test - post-test differences for engineers on the Social value scale of the Study of Values.

Hypothesis 3: There will be no significant pre-test - post-test differences for engineers on the Theoretical value scale of the Study of Values.

Hypothesis 4: There will be no significant pre-test - post-test differences for arts and sciences students on the Aesthetic value scale of the Study of Values.

Hypothesis 5: There will be no significant pre-test - post-test differences for arts and sciences students on the Social value scale of the Study of Values.

Hypothesis 6: There will be no significant pre-test - post-test differences for arts and sciences students on the Theoretical value scale of the Study of Values.

Data Analysis: All research hypotheses will be examined for statistical significance with the t-test. The t-test for both correlated and independent means will be utilized when appropriate. For purposes of the current research, the .05 level of significance was utilized in testing all hypotheses. In those cases where comparisons are to be made on small N's, the Wilcoxom Matched-Pairs Signed-Ranks Test will be employed.

RESULTS

Study I

The mean pre-test score on the awareness scale for the experimental group was 18.2, with a standard deviation of 5.25. The control group achieved a pre-test mean of 16.2, with a standard deviation of 5.21. (See figure 1.) A t-test for independent means finds the difference between the experimental and control pre-test score significant beyond the .01 level. This significant difference indicates a self-selection bias on the part of the experimental group, with respect to their pre-existing awareness of environmental events.

The post-test mean for the experimental group was 15.6 with a standard deviation of 5.26. The control group post mean on the awareness scale was 15.8 with a standard deviation of 5.78. The t-test for independent means between the post-test scores of the experimental and control groups was not significant at the .05 level. That is, there was no significant difference in awareness between the experimental and control groups, despite the experimental group's initial advantage and exposure to the course material itself.

A t-test for correlated means between the pre-test experimental scores and the post-test scores indicated a difference significant beyond the .01 level.

Table I
Statistical Comparisons of
Awareness Scale Data
(Study I)

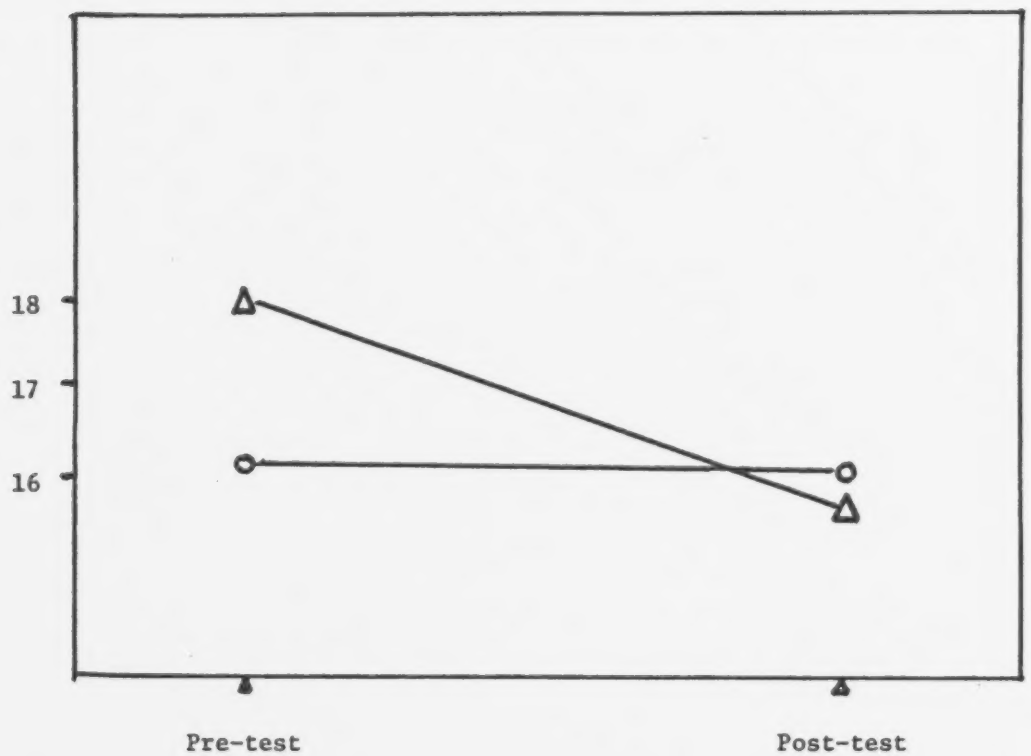
Exp. Pre - Exp. Post	t = 2.58	Sig. .01
Control Pre - Control Post	t = .67	N. Sig.
Exp. Pre - Control Pre	t = 2.92	Sig. .01
Exp. Post - Control Post	t = .17	N. Sig.

However, it is most important to note that this finding indicates a statistically significant drop in mean awareness scores.

A t-test for correlated means between the control groups pre- and post-test awareness scores was not significantly significant at the .05 level. The

Awareness of Environmental
Events Scale Scores

Figure 1



△ = Experimental Group

○ = Control Group

consistency in the scores of the control group in this test-retest procedure, would appear to lend strong support for the equivalence of the pre- and post-test instruments. That is, in the absence of any experimental treatment, the control group achieved almost identical scores on the retesting.

Study II

The following null hypotheses were examined in order to determine whether such a course experience can produce a change in the specified values.

The first hypothesis of Study II predicted no significant pre-test - post-test differences for engineering students on the Aesthetic value scale of the Study of Values.

Table 2
Study of Values Data
For Engineering Subjects
N=28

	Pre-test Means	Post-test Means	t	Sig.
Theoretical	49.57	48.54	.62	N.S.
Economics	43.78	43.78	0	N.S.
Aesthetics	36.86	37.57	.32	N.S.
Social	36.04	35.62	.17	N.S.
Political	40.71	40.65	.04	N.S.

As reported in Table 2, the differences between the pre-test and post-test scores on Aesthetics failed to reach the .05 level of confidence. The hypothesis of no significant difference was supported by the data.

Hypothesis 2 predicted no significant difference between pre-test and post-test scores for engineers on the Social value scale of the Study of Values. A t-test revealed no significant differences between the pre-test and post-test scores, thereby supporting the second hypothesis.

The third hypothesis predicted no significant difference between pre-test and post-test scores for engineers on the Theoretical value scale of the Study of Values. Once again, the difference between the pre-test and post-test scores failed to reach significance at the .05 level of confidence.

The fourth hypothesis predicted no significant differences between pre-test and post-test scores for arts and science students on the Aesthetic value scale of the Study of Values.

Table 3
Study of Values Data
For Arts & Sciences Subjects
N=19

	Pre-test Means	Post-test Means	t	Sig.
Theoretical	39.42	39.42	0	N.S.
Economics	37.95	38.63	.26	N.S.
Aesthetics	44.05	39.37	1.86	.05
Social	39.00	42.84	1.94	.05
Political	39.26	41.11	.88	N.S.

This null hypothesis was rejected with a t value of 1.86 being significant at the .05 level of confidence. That is, there was a significant drop in the Aesthetic value scores of the arts and science students, from pre- to post-test.

The fifth hypothesis predicted no significant pre-test and post-test differences for arts and sciences students on the Social value scale of the Study of Values. This hypothesis also failed to receive support. A t value of 1.94 was obtained, indicating significant increase in the arts and science students Social value scale scores.

Hypothesis 6 predicted no significant pre-test and post-test difference for arts and science students on the Theoretical value scale. This hypothesis was rejected at the .05 level of confidence. The change reflected an increase in Social values.

While no hypotheses were specified for either education or business administration majors concerning value changes, the investigators examined statistically the pre-test - post-test changes. Tables 3 and 4 report the obtained T values for the Wilcoxon Matched Pair Signed-Rank Test.

Pre-test and post-test comparisons of the education subjects on the Theoretical, Economic, Aesthetic, Social, and Political values scales failed to yield any significant differences. A Wilcoxon T value of zero was required to achieve significance at the .05 level of confidence. As noted in Table 3, none of the matched pairs comparisons yielded significant differences.

Table 4
Study of Values Data
For Education Subjects
N=6

	Pre-test Means	Post-test Means	T	Sig.
Theoretical	42.83	42.66	7.0	N.S.
Economics	36.66	36.66	10.5	N.S.
Aesthetics	43.17	46.00	0	.05
Social	40.16	39.00	7.0	N.S.
Political	36.66	34.16	5.0	N.S.

In the analysis of the data obtained from the business administration students with respect to the Study of Values, there were no significant differences on the Theoretical, Economic, Aesthetic, Social and Political value scales.

Table 5
Study of Values Data
For Business Administration Subjects
N-5

	Pre-test Means	Post-test Means	T	Sig.
Theoretical	45.40	43.60	1.0	N.S.
Economics	52.60	54.20	5.0	N.S.
Aesthetics	36.60	35.20	6.0	N.S.
Social	31.20	32.40	7.0	N.S.
Political	47.20	49.00	3.0	N.S.

CONCLUSIONS

As noted previously, the data from Study I indicate that the experimental group initially demonstrated a significantly greater degree of awareness of environmental events than did the control group. The differences between the experimental and control groups in the pre-test comparison was significant beyond the .01 level of confidence. This initial advantage, however, completely disappeared over the period of the course experience. The drop in awareness of the experimental group was of such a magnitude as to result in less awareness than the control group, who had not experienced the environment course. How can one explain this apparently bizarre phenomenon? One tentative explanation for this phenomenon is that the students in the experimental group experienced a 'stimulus satiation' with respect to environmental events. Given intensive exposure in the classroom to material dealing with environmental events, these students possibly became less receptive to the presentation of environmental events through the mass media. Psychology has long been aware of this phenomenon of novel stimuli eventually losing their effectiveness in eliciting responses. One could also conjecture, perhaps simplistically, in attempting to explain this unusual phenomenon. With finite amounts of time available for study of a given subject matter, one can understand the reluctance of students to invest time and effort (via exposure to the media) when faced with the rigorous demands of the "environment' course requirements. Activities external to the course demands can probably be more readily sacrificed to the pressures of course completion.

Of the 24 possible pre-test - post-test comparisons in Study II, only 3 reached a level of significance. In all three cases, the .05 level of significance was just barely achieved. Taking into consideration the fact that 24 comparisons were made, one might view these changes in values as a statistical artifact. By chance probability alone, at the .05 level of confidence, one would anticipate at least one pre-test - post-test comparison to reach significance out of 20 comparisons. The present research investigated 24 possible comparisons. One could reasonably expect between one and two to be significant by chance probability. The fact that there were three comparisons that reached statistical significance, does not necessarily represent treatment affect. It would seem parsimonious to interpret these differences as statistical artifacts, especially in view of the fact that the obtained differences barely reached a level of statistical significance.

In light of the foregoing data, one must raise the following question: Can formal educational programs be held responsible for effecting changes in values or in specific behaviors. One may be asking a given vehicle to bear too much of the burden e.g., formal education, in bringing about desired changes in human behavior. While there were obvious gains in terms of information and insights acquired in the environmental course, one would be over-optimistic in assuming that there would be an automatic change in values and behavior external to the course itself. A recent article, by sociologist Amitai Etzioni, (17) questions the assumed effectiveness of many educational efforts in such areas as drug abuse, smoking, and drunken driving. With respect to sustained educational programs, Etzioni suggests

that the effect of such programs on ingrained habits and basic values, is generally negligible. He contends that to solve social problems by changing people (via education) is more expensive and usually less productive than approaches which address the circumstances or the environment around the people.

While it is not the function of the current research to suggest means of solving the environmental and technological problems in our society, data from the current study seem to suggest that the "education is the answer" approach may be of minimal benefit.

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APPENDIX A

Science, Techology, and Society

Toward Relevance in Education

Lecture Topics

I. Introduction
   A. The Interrelationship of Science, Technology and Society
   B. Definition and Interrelationships of Mathematics, Science and Engineering

II. Environment
   A. The impact of technology upon man's environment and man's increasing environmental awareness; the value conflicts between progress and technology on the one hand and conservation, purity and wilderness on the other; Man's need to make educated choices within an ecosystem he is perceiving as increasingly inclusive.

   B. The use of natural resources; developing new choices of-new methods of choice and new criteria for choice of materials; responsibility redefined.

   C. The quality of the environment as it affects the quality of life; water, air, noise and aesthetics in relation to life style; social cost accounting and the systems approach.

III. Population growth in a world defined as overcrowded. The ethics of life; evolving definitions of life and death in the light of new scientific knowledge, engineering and philosophy; the privilege of giving birth; prolonging life or terminating; the interrelationships between birth, death, life space and the life support systems.

IV. The technology of urban existence and the patterns concentrated population groupings; as they relate to conformity, feds, escape techniques, economic distribution and the need for control.

V. Information and pseudo-information in relation to citizenship, technology and life style. The role of the computer in daily life; the kind of knowledge and skills required for "the good life" and appropriate techniques of conveying these - both hardware and software.

VI. The industrial system and technology; how, where and why man works. Management of the ecological commons through legal, social and political tools.

VII. Evolving techniques of handling aggression in response to new technology, new ideologies and new affluence; converting industrial capacity and manpower and energy from wartime to peacetime uses.

VIII. Man and the future; extrapolations, simulations, models and the systems approach. The future roles of man; specialist or generalist, isolationist, or world citizen. The complexities, value and criteria in the technological world of abundant choice and rapid change.

SCIENCE, TECHNOLOGY AND SOCIETY

Suggested Activities

1. Plan and implement a mini session. Write paragraph summary in log.
   a. Discussion group
      1. Choose a topic related to the unit
      2. Secure leader(s) - if subject is controversial have each viewpoint represented.
      3. Secure promise of 12-20 participants
   b. Project — Do something that will help you or others, understand the nature, of seriousness, of a problem related to this unit. (Use art, music, writing or speech, or do volunteer work-social or technical).
   c. Field Trip

2. Participate in mini session(s). Write (paragraph) summary in log.

3. Illustrate understanding of systems approach.
   a. Choose a problem (ex: What should be done about smog in Los Angeles?)
   b. Prose alternative solutions and their associated cost both economic and social.
   c. Choose one (optimize benefits)
   d. Write a one page summary

4. View film (titles to be announced)

5. Be prepared to demonstrate learning by writing in class - on assigned topics. (open log!)

6. Play the Ecology Game. Write one paragraph: Tell how you fared in the game. Evaluate the game as a learning experience.

7. Read material related to each topic, A,B,C,D, in the unit. Use reserve shelf, or other sources. Write a paragraph of summary and criticism.

8. Participate in class discussions. Use readings as background for comments and questions.

9. Summarize lectures and discussions.

APPENDIX B

Guidelines for Identifying "Major" News Stories

Newspapers

Importance of an article is usually connoted by its placement in the newspaper as determined by reader surveys. These may be designated in the following order:

Front Pages (the front page of the newspaper, and the first pages of any section page. These pages have the greatest readership)
Editorial Page
Pages 2,3, and 4 of the first section
The Page facing the Comic Strips

A story considered by the newspaper staff to be of importance that is placed within the paper may be identified by the following characteristics:

A headline two-columns wide or wider
A weighty headline (36 point type - or similar heavy, bold type - even though the headline may be only one column wide)
A headline with a subhead (a major headline, beneath which is placed a smaller headline above the body copy)
A headline with an eyebrow or other special characteristics (an eyebrow is a line of type, usually underlined, placed above the headline)
A news story with body copy 5 inches long or longer

Television

Programming

Length - any 30 or 60 minute program (usually will be in the form of a special)
Scheduling - ratings, determined by audience surveys divide the broadcasting time into the following categories:

Class A 7:00 p.m. - 10:30 p.m. all days (also called prime time)
Class B 6:00 p.m. - 7:00 p.m. weekdays; 1:00 p.m. - 6:00 p.m. Sund
Class C 9:00 a.m. - 6:00 p.m. and 10:30 p.m. - 12:00 midnight all
Class D 12:00 midnight -9:00 a.m. all days

Newscasts

Any report in the first portion of the newscast (a lead story, or one closely following it; or, more generally, any story in the newscast before sports or weather report
A report 2 minutes long or longer
A report accompanied by art (film, videotape, still photograph, etc.)

Radio

Any news feature, such as KRMG's "Accent" which is 60-90 seconds (runs outside newsca
Almost any story included in an hourly newscast that is of a serious nature. Especially a report that is repeated three or more times. These reports are usually shorter than a tv report due to length of radio newscasts--with the exception of KRMG's 30-minute "5:00 Report".